AID Report P-63-116

24 October 1963

PHENOMENA IN THE UPPER ATMOSPHERE

Compilation of Abstracts From Soviet Literature

AID Work Assignment No. 3
(Report No. 38 in this series)

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FOREWORD

This is the thirty-eighth in a monthly report series reviewing Soviet developments in selected problems in astrophysics and geophysics. It is based on materials received at the Aerospace Information Division in June and July 1963.

Topics covered in this series are as follows:

I. Ionospheric electron concentrations
II. Solar radiation and the ionosphere
III. Van Allen belts and cosmic rays
IV. Telluric currents
V. Atmospheric electricity
VI. Nuclear bursts in the atmosphere
VII. Satellite and missile data
VIII. Arctic and antarctic communications
IX. Meteorology of the upper atmosphere

Materials in this report deal with topics II, III, VII, and IX.

PHENOMENA IN THE UPPER ATMOSPHERE

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TOPIC II. SOLAR RADIATION AND THE IONOSPHERE

1) Danilkin, N. P. Vertical displacements in the ionosphere over Simferopol' during the solar eclipse of 1961. Geomagnetizm i aeronomiya, v. 3, no. 3, 1963, 473-478.

The effect of a solar eclipse on the ionosphere, particularly on the F-layer, over Simferopol' was investigated with a KAO automatic ionospheric station. Evaluated eclipse-contact and phase data for 100 and 250 km are given in tabular form, while variations in the electron concentration n_e for 140, 160, 180, 200, and 220 km heights are represented graphically. The graphs show a decrease in n_e during the eclipse at all heights, with a common minimum at 11:05 $\pm$ 0.6 min. A second minimum appears at 11:20 at 200 and 220 km. A second minimum was also observed at Rostov-na-Donu at the 180 and 200 km levels, with a 15-min time difference. The increasing electron concentration after the second minimum is attributed to an influx of electrons from higher levels, with an assumed velocity of 35 m/sec. Variations of the maximum ionization level (h_{max}) and the electron content (in a column with a 1-cm^2 base between the 140- and 200-km levels) are presented graphically. During the first half of eclipse they show a quite unstable h_{max} followed by a sharp and later steady decrease; the curve of the variations in electron concentration is smoother. Further numerical calculations are based on the solution of the equilibrium equation of ionization for the determination of the parameters M(h,t), characterizing the contribution made by the dislocation of electrons to ionization. The variations of M(h,t) at different levels during the eclipse, shown in curves, lead to the following conclusions. 1) The eclipse effect on variations of M(h,t) consist in an influx decrease, and even an outflux, of electrons at all heights investigated. 2) The influx of electrons to a given level at the end of the eclipse is greater than on control days. 3) the minimum (at 10:10) of M(h,t) curves is more distinctly expressed at lower levels. 4) The subsequent maximum of M(h,t) curves is displaced toward the maximum phase of the eclipse at lower levels. 5) The minimum of M(h,t) occurs somewhat before the maximum

phase value; this time interval increases at higher levels.

Author's Association: Rostov-na-Donu State University.

2) Drozdov, O. A., and T. V. Pokrovskaya. Analysis of statistical helioclimatic relationships. IN: Vsesoyuznoye nauchnoye meteorologicheskoye soveshchaniye. Trudy, t. 4: Sektsiya klimatologii (Transactions of the All-Union Scientific Meteorological Conference. v. 4: Section of Climatology). Leningrad, Gidrometeoizdat, 1962, 259-271.

Methodological questions dealing with statistical investigations of heliogeophysical relationships are examined in order to improve studies of the influence of solar activity on climate and weather. Long- and short-term cyclical changes in solar activity are correlated with hydrometeorological phenomena. Results obtained by Shnitnikov, Rubashev, Vitel's, Craig, Shapiro, Roberts, MacDonald, and others are said to show clear heliogeophysical relationships as well as a quantitative effect of solar activity.

Authors' Association: Main Geophysical Observatory.

3) Eygenson, M. S., and T. L. Mandrykina. Latest investigations of activity and geoactivity of the sun. IN: Vsesoyuznoye nauchnoye meteorologicheskoye soveshchaniye. Trudy, t. 4: Sektsiya klimatologii (Transactions of the All-Union Scientific Meteorological Conference. v. 4: Section of Climatology). Leningrad, Gidrometeoizdat, 1962, 271-278.

Sunspot-forming activity from 1900 to 1960, a period characterized as a branch of growth in the secular cycle, is studied in relation to geophysical phenomena. The duration of the branch of growth in the secular variation curve is considered the most important factor. The 11-year cycle, based on the Carrington-Spörer and Schwabe-Wolf laws, represents a combination of three factors: 1) total intensity of solar activity, 2) latitude of appearance, and 3) phase of appearance. If the plase of an 11-year cycle is designated by t, the total intensity by ΣP, and the heliographic latitude by φ, the laws of 1) latitudinal distribution, 2) Carrington-Spörer, and 3) Schwabe-Wolf, may be written in the form

$$1) \quad P = \Phi_1(\varphi)$$

$$2) \quad \varphi_{mod} = \Phi_2(t)$$

$$3) \quad \Sigma P = \Phi_3(t).$$

It is seen that all the laws are interrelated and that solar geoactivity is a function of both ΣP and φ. Becker's conclusion (reference given) that the active zone consists of two subzones in each hemisphere, developing and shifting in phase, is held to be erroneous.

Authors' Association: L'vov State University.

4) Gnevyshev, M. N. The corona and the 11-year solar activity cycle. Astronomicheskiy zhurnal, v. 40, no. 3, 1963, 401-412. QB1.A47, v. 40

Measurements made of the intensity of coronal line 5303 A made at Kislovodsk, Pic du Midi, Mt. Norikura, Climax, and Sacramento Peak are compared. Similar absolute values and variations are noted in the records of Kislovodsk and Pic du Midi, indicative of the similarity and stability of the photometric systems used in these stations and of the probable validity of the values determined. Linear relationships whose coefficients differ for different time intervals must be employed to reduce the data obtained by the American stations and Norikura to the Kislovodsk and Pic du Midi system. Two maxima of activity are noted in the current solar activity cycle -- the first in 1957 and the second in 1959-1960. The first maximum was characterized by the fact that the coronal brightness increase and decrease occurred simultaneously at all latitudes from the equator to the poles with a maximum at $\varphi = 25°$. The second maximum manifested itself only in the low latitudes. Both maxima are similar with regard to the amount of energy emitted by the corona and prominences. Spot-forming activity reached its greatest development one year before the maximal coronal emission in both maxima. Maximal coronal emission was observed during the periods of greatest decrease of spot formation activity. The conclusions arrived at through analysis of the current cycle may be applied to other 11-year cycles for two reasons: a) During all eclipses in years of cyclic maxima an enhancement of coronal emission around the entire solar disk is invariably observed, while in years of fall-off to minima, intensive emission is observed in the equatorial region, and b) During all 11-year cycles observed, the Spörer curve has a similar appearance. In the second half of the cycle the latitude, after decreasing to a value of around 10°, thereafter remains unchanged.

Author's Association: Mountain Astronomical Station; Main Astronomical Observatory of the Academy of Sciences, USSR, Kislovodsk.

5) Gulyayev, R. A., K. I. Nikol'skaya, and G. M. Nikol'skiy. Structure of the solar atmosphere in active and undisturbed regions. Ionization of hydrogen and helium. Astronomicheskiy zhurnal, v. 40, no. 3, 1963, 433-445.
QB1.A47, v. 40

Active and undisturbed regions of the solar atmosphere are examined under two assumptions: 1) there is regional homogeneity and 2) total mixing occurs throughout the solar atmosphere, i.e., the chemical composition is independent of height. The distribution of temperature T, neutral hydrogen $n_{H\,I}$, and electron concentration n_e in the lower chromosphere at $h \geq 1000$ km has been found from eclipse observations in Sr II and the Balmer continuum by Thomas and Athay [reference given]. The data obtained are in good agreement with the model of the transition region and corona given by Ivanov-Kholodnyy and Nikol'skiy [reference given] for $h \geq 5000$--7000 km. Different He and H ionization mechanisms are discussed. The distribution of H I, He I, He II, and He III is found at heights from 1000 km to the inner corona. Short-wave solar radiation plays a large role in the ionization of H and He in the chromosphere and in the transition region. The theoretical computations of continuous He emission at $\lambda \leq 504$ A and $\lambda \leq 228$ A are in good agreement with rocket data.

Authors' Association: Institute of Terrestrial Magnetism, Ionosphere, and Radio Wave Propagation, Academy of Sciences USSR.

6) Kazimirovskiy, E. S. Wind systems in the lower ionosphere. Geomagnetizm i aeronomiya, v. 3, no. 3, 1963, 463-472.

The results are reported of unified processing of data on horizontal drift of ionization inhomogeneities in the ionosphere. The data analyzed were drawn from measurements made at 90 to 100 km by a world-wide net of 34 stations during the IGY and IGC (1957-1959). To obtain average diurnal variations of the drift velocities and their dependence on the time of day, all data were grouped into quarterly (seasonal) classes and the evaluation of zonal (W-E) and meridional (N-S) drift components was made separately for each station for every hour of each season. For eight stations of the Northern Hemisphere (20-60°), the drift velocities measured over 24 hr are set up in mean annual curves for which a general equation is given, showing that besides a general circulation there is an additional influence by thermal (24-hr period) and gravitational (12-hr period) forces. The results of this analysis are given in tables. The presence

of only one system in the regular motions in the lower ionosphere is indicated in two figures showing the regular formal drift in winter and summer. In the Northern Hemisphere winds are westerly in summer and easterly in winter; in the Southern Hemisphere the reverse is true. In the winter the regular meridional drift in the zone of 55-60°N--55-60°S is directed to the equator, while high altitudes it is toward the poles. In western and northern Europe there is a regular drift toward the pole in summer; in other areas, however, it is toward the equator. Analysis of wind velocities revealed that there are two vectoral rhythms, one of 24 hr and the other of 12, corresponding to one or two elliptical revolutions of the velocity vector in 24 hr. The main parameters of the wind systems depend chiefly on latitude, but also depend on the season; their global distribution in the 20-70°N interval is presented graphically. The hypothesis is confirmed that the ionization inhomogeneities in the E-region and ionized meteoritic traces form at greater heights in winter than in summer. The final results of analysis of the measured wind systems are compared with theoretically derived systems and possible reasons for the differences noted are discussed.

Author's Association: Institute of Terrestrial Magnetism, Ionosphere, and Radio Wave Propagation, Siberian Branch of the Academy of Science USSR.

7) Kuliyev, D. M. On the central intensities of strong Fraunhofer lines of the solar spectrum. IN: Leningrad. Universitet. Vestnik, no. 7, Seriya matematiki, mekhaniki i astronomii, no. 2, 1963, 155-160.

The central residual intensities r_{ν_0} of strong Fraunhofer lines may be used to determine the relative role of true absorption, pure scattering, noncoherent scattering, fluorescence, etc. in the upper layers of the solar and stellar atmospheres. To date the theoretical and experimental values of the central residual intensities have been divergent. Mel'nikov [reference given] detected that the nature of the change of the central residual intensities of the Fraunhofer lines of the solar spectrum with wavelength is practically independent of the kind of atoms, oscillator strength, and so on. He found that the central residual intensities, on the average, increase in the red end, according to the law $r_{\nu_0} \sim \lambda$, regardless of their equivalent widths.

Spectrograms with several strong Fraunhofer lines were obtained with the Leningrad University tower telescope, used in conjunction with an autocollimation diffraction spectrograph. The dependence of r_{ν_0} on λ for 14 strong lines is shown

graphically, using averaged values. It is seen that the law found by Mel'nikov also holds for strong absorption lines. The fraction of atoms pre-excited by collisions of the second type was computed for the 14 lines and was seen to increase from the center to the limb of the solar disk. Two reasons are suggested to explain the relatively high r_{ν_0} values observed for the strong Fraunhofer lines: 1) the effect of the Fraunhofer lines on the level of the continuous solar spectrum being recorded, and 2) the influence of chromospheric radiation in the frequencies of the lines studied.

8) Kuz'minykh, V. D. On the dependence of facula contrast on wavelength. Determination of the spectrophotometric temperature of faculae. Astronomicheskiy zhurnal, v. 40, no. 3, 1963, 419-426 QB1.A47, v. 40

In an earlier work [See AID Work Assignment No. 3, Report 33, Topic II, Abstract 3] the author presented the results of photographic investigations of facula-photosphere contrast for about 60 facula. In this work the dependence of contrast on wavelength is investigated and the spectrophotometric temperatures and facula gradients at different distances from the center of the disk are determined. The dependence of facula contrast on wavelength for different values of sin ϑ (through 0.1) are shown graphically. With increasing distance from the center of the solar disk the curves at first ascend almost parallel to each other up to sin $\vartheta \simeq 0.5$. Then the ultraviolet fraction of facula radiation increases more rapidly than the photosphere and there is a slow ascent of the curves in the visible region of the spectrum (up to sin $\vartheta \simeq 0.7$). Then, as the distance with maximum contrast (sin $\vartheta \simeq 0.87$) is approached, the visible component grows more quickly than the ultraviolet. As the limb of the disk is approached (in the sector from 0.85 to 0.98), a reverse trend is noted. The center of the solar disk is adopted as a comparison source for the determination of spectrophotometric gradients and temperatures. The absolute spectrophotometric gradients and temperatures for different sin ϑ are given. The facula-photosphere temperature difference is found to be 350-400° on the average. Maximal facula temperature is found at about $\vartheta \simeq 50°$.

Author's Association: Astronomical Institute imeni P. K. Shternberg.

9) Nikol'skiy, A. P. On the geographic distribution of magnetic disturbances, radio-wave absorption, and radar reflections from auroras in the high latitudes. Geomagnetizm i aeronomiya, v. 3, no. 3, 1963, 514-519.

Observational data on radio noise obtained on Medvezhiy Island, magnetic disturbances recorded at Cape Chelyuskin, and radar reflection from auroras obtained at Medvezhiy Island

were analyzed. The daily distributions of these phenomena are found in many cases to be similar. Stations located between 65° and 72° geomagnetic latitude and from 0 to 220° longitude apparently pass under solar-related ionized regions three times a day. Correspondingly, the probability of appearance of magnetic disturbances increases three times a day. It is postulated that the maxima of magnetic activity, blackout recurrence, and frequency of appearance of auroral reflecting regions are related to the influx of solar corpuscles into the shock zone region along Störmer's spirals.

Author's Association: Arctic and Antarctic Scientific Research Institute.

10) Nikol'skiy, G. M. On the temperature of the solar corona. Geomagnetizm i aeronomiya, v. 3, no. 3, 1963, 417-430.

Various methods of determining the electron temperature in the solar corona are discussed. At present the most reliable values are obtained from the ionization theory. Radioastronomical methods could yield more reliable temperature data, but a radical increase in the resolving power of radiotelescopes in the cm and dm ranges, up to 10" x 30", would be necessary in order to delimit a sector of the corona at the solar limb. Line emissions due to ions with different ionization potentials emanate from different coronal regions, which can be distinguished by temperature. This agrees with the ideas developed by Shklovskiy in 1950 [reference given]. However, there should be more than three such regions. The value of emission

$$\int n_e^2 dl,$$

characterizing the radiation of a definite ion, depends on the ionization temperature of the latter. The curve in this case has a rather sharp maximum in the region $T \sim 1.5 \cdot 10^6$ degrees. This dependence can be explained when one assumes the existence in the corona of different temperature elements with dimensions of $\sim 10^9$ cm. Line broadening in the corona is caused to a considerable degree by turbulent motions with velocities of ~ 20 km/sec. There is reason to believe that these velocities differ in regions of different temperature, so that the velocities in the "cold" regions are greater than those in the "hot" regions.

Author's Association: Institute of Terrestrial Magnetism, Ionosphere and Radio Wave Propagation, Academy of Sciences USSR.

11) Obridko, V. N. Profile of the K_{232} line and structure of the solar chromosphere. Astronomicheskiy zhurnal, v. 40, no. 3, 1963, 446-454. QB1.A47, v. 40

The profile of line K_{232} has been computed on the basis of the Thomas-Jeffreys theory. With n_e assumed constant, several conclusions are reached. 1) The Thomas-Jeffreys theory describes the profile of line K_{232} with complete satisfaction. 2) The central part of the line originates in a region with an unusually sharp temperature increase. 3) A temperature vs. height survey made by means of the function $\Delta\phi(h) = n_e^2 T^{-3/2}$ shows that the temperature in the active region is somewhat lower than in a disturbed region at the same height. 4) The height at which the sharp temperature increase begins in an undisturbed region is obtained through analysis of eclipse observations. This height (4000 km) coincides with that obtained by the author from analysis of the profile of line K. To obtain a further improved profile of the line, changes of n_e and $\Delta\lambda_D$ with height would have to be taken into account in the initial formulas.

Author's Association: Institute of Terrestrial Magnetism, Ionosphere, and Radio Wave Propagation, Academy of Sciences USSR.

12) Popov, N. P. Vertically displaced disturbances in the ionosphere according to observations in Irkutsk. Geomagnetizm i aeronomiya, v. 3, no. 3, 1963, 576-578.

Recordings were made at 1-2 min intervals of vertically displaced disturbances of 30-70 min duration by the ionospheric station in Irkutsk. Records made on 1 October and 9 December 1961 and 29 January 1962 were selected for detailed investigation. Twelve of the ionograms obtained, with characteristic traces of appearance and development of the observed disturbances, are presented as graphs. A diagram shows a change of $\pm 10\%$ in the critical frequency of the F2 layer occurring during intense appearances and motion of vertically displaced disturbances. The following conclusions were reached. 1) The frequency of appearance of vertically displaced disturbances has a diurnal maximum; the appearance of disturbances causes bay-like changes of the f_0F2 of $\pm 10\%$. 2) In the Northern Hemisphere these disturbances are observed mostly in the winter months. 3) They cause a short-duration appearance of the E_s layer at 100-160 km or increase its reflecting ability. 4) These disturbances effect a separation of the F layer in the winter months, which is interpreted as formation of the F1 layer.

Author's Association: Institute of Terrestrial Magnetism, Ionosphere, and Radio Wave Propagation, of the Siberian Division, Academy of Sciences, USSR.

13) Romanchuk, P. R. Formation of sunspots and solar magnetic fields. I. Astronomicheskiy zhurnal, v. 40, no. 3, 1963, 477-486. QB1.A47, v. 40

The author rejects the theories formed by T. G. Cowling and by L. E. Gurevich and A. I. Lebedinskiy on the formation of the magnetic field of sunspots and in their place proposes his own. It is assumed that the magnetic fields in sunspots are of the same nature as the coronal and general fields. The sudden motion of young spots westward is believed to be caused by the release of the moment of momentum from the subphotospheric layers. The sunspot magnetic field appears in the form of rings along a vertical plane created by convective motion. The change of polarity by bipolar sunspot groups at the onset of a new cycle of solar activity is connected with the change of polarity of the general solar magnetic field. The author further assumes that the general solar magnetic field is projected into space by corpuscular streams. The di 'ntegration of the magnetic fields of sunspot groups and local bipolar regions of a cycle of solar activity forms a new general magnetic field.

It is hypothesized that the convective motion of the plasma elements across a weak general solar magnetic field in the subphotospheric layers causes an inductive current around which magnetic fields form. The plasma elements rise and, simultaneously, the masses of adjacent regions sink. The magnetic fields of convective plasma elements rising from the subphotospheric layers may appear on the solar surface, forming the ring-shaped magnetic fields of bipolar spots. Magnetic fields of opposite polarity are neutralized; this process may be connected with the generation of chromospheric flares. The main spots are surrounded by magnetic regions of opposite polarity. The author summarizes his hypothesis as follows: strong magnetic fields of sunspots can be formed by large convective streams in the subphotospheric layers in a weak general solar magnetic field. The strong magnetic fields are produced by the kinetic energy of plasma streams which cause inductive currents.

Author's Association: Astronomical Observatory of Kiyev University.

14) Yevlashin, L. S. Some regularities in the behavior of the hydrogen emission in auroras. Geomagnetizm i aeronomiya, v. 3, no. 3, 1963, 496-501.

Observations made in the years 1957-1961 were used for investigating the regularities of the first appearance and final disappearance of H emission at the Murmansk station located near the zone of maximum auroral frequency. Observational data are tabulated, and the results of the investigations are repo[illegible]ented

graphically on four maps of the northern polar region. It is shown that the latitudinal variations in the H-emission region of auroras (55 - 75°Φ) depend on both local time and geomagnetic activity. The influx of H atoms connected with auroras occurs on some days simultaneously with the appearance of a large annular band near the zone of maximum auroral frequency. In the course of 24 hours this band moves over the circumpolar region as one body, in dependence on the Earth's position relative to the Sun. It is evident that the concentration of protons in the Arctic can cover quite a large region at one time. This suggests the spiral precipitation of solar corpuscles described by Störmer. The investigations indicate that there are two spiral mechanisms introducing corpuscles in the circumpolar zone: a proton mechanism and an electron mechanism. Of these, one covers the night side of the Earth and the other, the day side.

Author's Association: Polar Geophysical Institute, Kola Branch of the Academy of Sciences USSR.

TOPIC III. VAN ALLEN BELTS AND COSMIC RAYS

1) Trakhtengerts, V. Yu. On the mechanism of generation of ultralow-frequency electromagnetic radiation in the outer terrestrial radiation zone. Geomagnetizm i aeronomiya, v. 3, no. 3, 1963, 442-451.

It is shown that the distribution of electrons with regard to their velocities in the outer radiation zone may be unstable with respect to low-frequency electromagnetic vibrations. This instability is used to explain the origin and some characteristics of the ultralow-frequency radiations in the terrestrial exosphere. Only ULF radiation of the continuous type, covering a wide band of frequencies in the range from 1 to 30 kc with a maximum intensity at 5 kc, is discussed. For the most part the radio noise lasted 1.5 to 2 hr, but occasionally it lasted over 10 hr. Proceeding from Parker's general equation, which represents a function $\Phi(\varphi,\theta)$ for the dependence of the density of particles on the coordinate φ along the selected line of force and on the angle θ between the vector of impulse of particles and the magnetic field direction, two formulas for the damping coefficient q are derived for the limiting conditions

$$a^2 \pm 1.0 \gg p_\perp^2$$

and

$$a \pm 1.0 \ll p_\perp^2,$$

where a is a functional parameter and $p_\perp$ is the transverse impulse vector on the magnetic field H. For the intensity of radiation ($I_{\pm 1,0}$) equations are given for integer values (± 1, 0, 1, 2...) and arbitrary values of the anisotropy coefficient γ; the equations are valid for small angles of α between the wave vector k and H:

$$\alpha < \alpha_{lim} = \arcsin \frac{\omega_H}{kv_T} < \frac{\pi}{2},$$

where v_T is the mean heat velocity of particles and ω_H is the frequency in the plane of H. The equations show that the damping coefficient q increases with decreasing frequency at a sufficiently high mean heat velocity of particles in the radiation zone, and that instability is possible at frequencies

$$\omega < \omega_{lim} = \frac{\gamma\omega_H}{\gamma + 2} \quad \text{at } \gamma > 0.$$

Observations by satellites and rockets proved the presence of a significant instability in the distribution of electrons along the magnetic lines of force at the height of the outer terrestrial radiation zone. This indicates a considerable anisotropy

of electrons; generally, in undisturbed periods $\gamma \approx 1$, but it increases up to 2 during magnetic storms. A numerical computation is given as an example of an exponential electron distribution for altitudes up to 13,000 km; a constant electron concentration of 100 cm^{-3} is assumed in higher zones. For the most intensive part of the radiation zone a frequency of F_{max} $(r = 3.5r_o) = \omega_{max}/2\pi =$ 4.8 kc, increasing in magnetic storms, is derived. This agrees with the experimentally obtained value of 3-9 kc. Dislocating the radiation zone from $r = 3.5\ r_o$ by $1/2\ r_o$ effects a change of f_{max} by ∓ 2.4 kc; an increase in γ causes an increase in f_{max} and in ULF radiation. The ratio of the intensities I_1/I_2 at frequencies $f_1 = q$ and $f_2 = 230$ kc, assuming that F_1 and F_2 are generated at heights $h_1 = 11{,}300$ and $h \approx 2000$ km and that the electron density N_n is 3-5/cm^3, was found to be

$$\frac{I_1}{I_2} \approx e^{2.3 N_n} \sim 10^4 - 10^5.$$

This correlates quite well with observational data, which give $I_1/I_2 \sim 3 \times 10^3$. Apparently, the radiation intensity is most affected by changes in electron concentration; therefore, ULF noise increases by many times in periods of maximum electron density, which occur during auroras and generated phases of magnetic storms. Generally, ULF frequencies may serve as an effective mechanism for creating particles which produce middle-latitude auroras (if the condition $a \pm 1 \ll p_\perp^2$ is fulfilled). These auroras are always accompanied by ULF noise and located in the zone of geomagnetic latitudes $\Delta\varphi \sim 52\text{-}58°$. This corresponds well with the location of the outer radiation zone.

Author's Association: Radiophysics Institute of Gor'kiy State University.

TOPIC VII. SATELLITE AND MISSILE DATA

1) Krasovskiy, V. I., Yu. I. Gal'perin, V. V. Temnyy, T. M. Mulyarchik, N. V. Dzhordzhio, M. Ya. Marov, A. D. Bolyunova, O. L. Vaysberg, B. P. Potapov, and M. L. Bragin. Some characteristics of geoactive corpuscles. Geomagnetizm i aeronomiya, v. 3, no. 3, 1963, 401-407.

The technical specifications and operating conditions of the instrumentation (fluorescent-screen indicators, fast charged-particle traps, Geiger counters) used on Kosmos-3 and Kosmos-5 are described in some detail. Preliminary analysis of data obtained indicated that three separate groups of very intensive corpuscles exist:

1) Very hard corpuscles recorded by the Geiger counter. They cause up to 100 counts/$cm^{-2}sec^{-1}ster^{-1}$. It is admitted that the counter used was too primitive to reveal the true nature of the corpuscles.

2) Electrons with an energy of about 100 Kev. Their maximal flux reaches $2 \cdot 10^7$ particles/$cm^{-2}sec^{-1}ster^{-1}$.

3) Electrons with an energy of 10^2-10^4 ev. Their maximal flux reaches 10^8 particles/$cm^{-2}sec^{-2}ster^{-1}$, when the electron energy is about 10^4 ev.

The second group of corpuscles constitutes a substantial part of the energy in the inner radiation zone. Electrons with energies of 10^2-10^4 ev, first detected by the third satellite over the high latitudes, are now recorded over the lower latitudes, to 30--35° N. However, no such electrons were detected over the southern part of the Atlantic Ocean.

Authors' Association: Institute of Physics of the Atmosphere.

2) Krasovskiy, V. I., Yu. I. Gal'perin, V. V. Temnyy, T. M. Mulyarchik N. V. Dzhordzhio, M. Ya. Marov, and A. D. Bolyunova. Some new results of geophysical investigations with "Kosmos 3" and "Kosmos 5." Geomagnetizm i aeronomiya, v. 3, no. 3, 1963, 408-416.

The results of measurements of corpuscular radiation in the upper atmosphere by Kosmos 3 and Kosmos 5 indicate the existence

of three distinct energetic groups:

1) Protons with energy $\geq$ 50 Mev or electrons with energy > 0.4 Mev, capable of acting on a Geiger counter screened by 3.4 g/cm^2 Pb and 0.8 g/cm^2 Al, or directly at energies > 10 Mev or by x-radiation at lower energies.

2) Electrons with energy ~ 100 Kev.

3) Electrons with energy of several Kev or tens of Kev.

The intensity and spatial distribution of particles is more stable in the first group than in the second, while the particles of the third group are sporadic. The region of the geomagnetic field closest to the earth was chiefly populated by electrons with comparatively low energy and not with protons with an energy $\geq$ 50 Mev. Lines of equal intensity at heights of ~ 650 km over the South Atlantic magnetic anomaly are shown graphically for the first and second groups, respectively. Sporadic streams of corpuscles of the third group are most intensive in the high-latitude regions. Their energy and anisotropy in the geomagnetic field are constant. In addition to the corpuscular groups mentioned, significant positive streams were sometimes recorded by the ion traps. The rates of braking of Kosmos 3 and 5 indicate that the density of the atmosphere near perigee, at a height of about 200 km, was somewhat less in 1962 than in 1958. Increased satellite braking during geomagnetic disturbances is caused by an increase in the density of the atmosphere at heights of about 200 km and attests to the heating up of the upper atmosphere at this time.

Authors' Association: Institute of Physics of the Atmosphere.

TOPIC IX. METEOROLOGY OF THE UPPER ATMOSPHERE

1) Bobrov, M. S. Magnetic disturbances at conjugate points as a source of data on the outer atmosphere and solar corpuscular radiation. Geomagnetizm i aeronomiya, v. 3, no. 3, 1963, 537-545.

For 92 successive days during the IGY (1 Aug through 31 Oct 1958) the magnetograms of Murchison Bay and Mirnyy stations (two conjugate polar cap observatories) and Uelen and Maccuri stations (a conjugate pair in the auroral zone) were correlated according to Universal Time. A good round-the-clock agreement of simultaneous disturbances at Uelen and Maccuri was detected, and a clear daily agreement between Murchison Bay and Mirnyy with a minimum in the morning hours (geomagnetic time) was noted. The agreement between Uelen and Maccuri indicates that the force tube connecting a pair of observatories is, generally, able to conduct geomagnetic disturbances at any hour of the day without great distortion and without changing the state of polarization. The diurnal agreement between Murchison Bay and Mirnyy shows that at certain hours a force tube based on a sufficiently high-latitude observatory is systematically subjected to an agent adversely affecting its conductivity. Inasmuch as the decrease of conductivity occurs in the morning and diurnal hours it is clear that the agent is of solar origin. The agent is believed to be corpuscular in nature (solar wind, corpuscular streams from flocculi, and chromospheric flares). Physically conjugate geomagnetic disturbances provide information on the outer atmosphere and corpuscular radiation. For example, they may be used to determine the directions at which corpuscular streams from flares arrive at the boundary of the outer atmosphere, the relationship between the longitudinal extent of the region of decreasing conductivity and the level of magnetic disturbance, the constancy of the parameters of solar wind in time, and so on. The advantage of information derived in this manner is its systematic nature and the fact that the phenomenon can be studied for a long time interval regardless of the state of the surface of the sun and the interplanetary medium.

2) Leonas, V. B. On one possibility of measuring the temperature in the upper atmospheric layers. Geomagnetizm i aeronomiya, v. 3, no. 3, 1963, 574-575.

A method has been developed for measuring the temperature of the upper atmosphere by means of satellites. The method is based on the analysis of the transit-time distribution of particles in a molecular beam. In order to obtain an expression

for a velocity distribution when the beam intensity is assumed to be modulated by rectangular pulses, an analysis was made for the case when the beam is constant in regard to time and uniform in regard to its mass. The normalized function of the velocity distribution $f(v)$ is found to be $f(v) \approx it$, where i is an ion current and t is an arbitrary moment of time. In the practical application of this method, the beam caused by the motion of a satellite passes to a receiver through a chopper disk, which forms short rectangular pulses. Distortions of these pulses caused by the difference in particle velocities, as well as the particle velocities themselves, are determined. After the separation of the velocity component caused by thermal motion of the unperturbed medium from the component due to satellite motion, the temperature is determined on the basis of a comparison of the thermal component with the Maxwell velocity distribution of particles. It is noted that in this method measurements are practically not affected by degassing and reflection from the equipment of particles passed through the disk. The method is limited by the effectiveness of registering but not by the altitude; at an effectiveness of 10^{-3} it could be used up to 400 km.

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